Local Plan 2040 Preferred Options
Net zero buildings background paper

1. Introduction

The Council published its initial issues consultation for the new Local Plan in the summer of 2021 and as part of the consultation we included a background paper which addressed the issue of carbon reduction, particularly in new buildings. The paper set out the relevant national, regional and local policy context for this topic; then went on to set out the key issues of relevance to the city; before highlighting some potential approaches that could be pursued in developing new policies. This paper should be considered as a continuation of that issues paper, as such for brevity, other than the summary below, it does not repeat content here.

This background paper addresses the development of the sets of policy options that relate to net zero carbon buildings which we are consulting on as part of the Local Plan 2040 preferred options consultation. The paper sets out wider context and more technical details that have been considered in formulated the various options set out in table R1, R2 and R3 of the main consultation document.

2. Context including feedback from Issues consultation

2.1. Summary of 2021 Issues consultation

The 2021 background paper identified that the built environment is the primary contributor to Oxford carbon footprint, followed by transport. It set out the significant contribution that heating and powering buildings has to carbon dioxide emissions, and identified that there is a significant need for retro-fitting existing buildings. If the city is to meet its objectives of becoming zero carbon by 2040, let alone national targets of achieving zero carbon by 2050, then it is also important that we ensure that any new development occurring in Oxford is fit for a zero carbon future.

The paper set out several options that we might want to consider as we develop options for new policies including:

- Energy hierarchy – fabric first approaches
- Potential for larger scale renewable energy generation in city
- Low/zero carbon heating/cooling
- Issue of unregulated energy, performance gap, embodied carbon
- Role of offsetting
- Supporting retrofitting existing buildings, also balance with heritage

2.2. Feedback received from consultation

Feedback from the summer consultation was varied, reflecting the broad scope of the issues consultation.

Natural England supported the net zero aspiration and the role that was identified for green infrastructure in driving climate adaptation. They flagged that the role of the new/restored habitat in delivering multi-functional benefits and that plans should be aligned with the Nature recovery network. Berkshire, Buckinghamshire Oxfordshire Wildlife Trust BBOWT, equally welcomed the priority given to the climate emergency, they felt it essential that the plan secures high construction

standards and zero carbon development, and that polices ensure urban heat island effects are minimised as well as surface water runoff.

Historic England flagged that it needs to be recognised that historic buildings are likely to require different retro-fitting strategies and approaches than modern buildings.

The **County Council** wished for more reference to the 'circular economy' and that Oxford needs to decide what the definition of net zero carbon looks like for the city. They also flagged that the issue of embodied carbon needs further consideration, and that methods to reduce it should be championed by the Plan.

There were a wide variety of other comments covering a broad range of issues and concerns including:

- Acknowledgement of significant challenges and steps required in reducing emissions as a city, but also of the risks presented by flooding, overheating etc.
- Need to determine what zero carbon means for oxford (definition)
- Lots of reference to need for additional greening, enhancement of existing spaces, protection of green spaces – concern about loss of this for development
- Concern about balance between growth ambitions and climate consequences
- Concerns about flood risk, as well as rising temperatures.
- Need to consider embodied energy/carbon
- Need to address waste streams and encourage more recycling
- Need to consider adaptation measures including nature-based solutions
- Transport considered a significant issue as much as buildings
- Incorporation of circular economy principles
- Need to plan seriously for energy, local energy generation, EVs, renewables.
- Sensitive retrofit of heritage buildings (different strategy to modern)
- Policies need to be flexible to accommodate changing technologies

2.3. Updates to national/local policy context since 2021 issues consultation

The 2021 Carbon Reduction background paper set out the key national policy context for this topic and is still of relevance for the purposes of this background paper. However, since that paper was written, there have been several updates which are worth highlighting here, as they are likely to have relevance to how any new policy in the Local Plan 2040 is formulated.

Building Regulations interim uplift

The government has now published details of the interim uplift it plans to make to Building Regulations in advance of full implementation of the Future Homes and Future Buildings Standards in 2025. The interim uplift, which came into effect from June 2022, is expected to improve the quality of new build development so that it achieves a 31% reduction in carbon dioxide emissions compared with the current baseline. Policy RE1's 40% reduction target will continue to be sought on top of these new Building Regulations standards, and this should result in much more stringent requirements for regulated emissions – though it should be noted that neither the interim uplift, nor full Future Homes/Buildings Standard as currently proposed, will address unregulated emissions or embodied carbon.

Sixth Carbon Budget

The UK has already set into law a target of attaining a 100% reduction in greenhouse gas emissions by 2050, compared to 1990 levels. In June 2021, based upon advice from the Committee on Climate

Change which was set out in their Sixth Carbon Budget report[1], the Government further enshrined into law a target of reducing greenhouse gas emissions by 78% by 2035 compared to 1990 levels. The updated budget and its associated recommendations highlight the significant shifts towards net zero technologies and decarbonisation of energy, heating and transport systems that are needed in the immediate future (and during the Local Plan time frame).

Third UK Climate Change Risk Assessment

At the beginning of 2022, the Government published its third Climate Change Risk Assessment, which identifies the key risks presented by climate change to different parts of society and the economy. The assessment highlighted that there are significant ongoing risks presented by climate change and that radical progress is still required to act on these and build resilience to anticipated impacts. Planning processes can play a major part in anticipating the risks presented by climate change to local areas and to build in the necessary adaptation across the built environment.

Zero Carbon Roadmap

The Zero Carbon Oxford Partnership, of which Oxford City Council is a key part, published its Zero Carbon Action Plan and Roadmap in 2021. This sets out a pathway towards making Oxford a Zero Carbon City by 2040 and includes rigorous stepped targets for decarbonisation across major sectors in the city, including the built environment, which the new Local Plan will be able to support.

Council motion re: UKGBC definition

The Council officially agreed a motion to adopt a consistent definition of net zero for buildings that was in line with the UK Green Building Council (UKGBC). This had two parts, one describing net zero carbon construction and the other describing net zero carbon operational energy.

2.4. How are current Local Plan 2036 policies performing?

Analysis from 2020/21 Authority Monitoring Report (AMR)

At the end of 2021, the Council published its first AMR reporting upon performance of policies within the Local Plan 2036 since its adoption in 2020. Whilst there was limited monitoring data, as the policies had not been in force for a full year upon writing, the AMR was able to present some analysis in relation to the key policy that addresses climate change – policy RE1.

Analysis in the AMR highlighted that all but one of the applicable major proposals permitted during 2020/21 met the requirements of RE1 demonstrating at least a 40% reduction in regulated carbon emissions as required by policy RE1. This finding is positive in that it suggests that all relevant applications are meeting the objectives of the current plan with respect to carbon reduction. However, the report also highlighted that due to heritage complications, one application could not meet RE1's requirements in full, though officers had noted in their decision report that the proposal had maximized energy efficiency where possible. The report also highlighted that water efficiencies were being utilised in all relevant applications, but that it was difficult to monitor whether they were meeting the specific 110 litres per person per day target as set out in policy RE1.

Summary of any key feedback from DM and Specialists discussions

Discussions with members of the development management team, who have experience of applying the existing policies, as well as specialists within the Council have highlighted several wider issues for the new Local Plan to address including:

[1] https://www.theccc.org.uk/publication/sixth-carbon-budget/

- RE1 only targets regulated emissions – currently, the policy is silent on the topics of unregulated and embodied carbon.
- Fossil fuel burning boilers are not explicitly ruled out through current policy and would be permissible in some circumstances. Where installed in new development, they are likely to equate to a future retro-fit issue which could carry significant costs for occupiers.
- There are conflicts between heritage constraints and carbon reduction aspirations in certain areas of the city particularly where installation of renewable energy technology is concerned.
- It can be challenging to monitor compliance with certain elements of the Local Plan's policies.
- It is difficult to apply the requirements of RE1 to extensions, conversions, indeed the existing policy does not explicitly apply to this type of development.

2.5. What does all this mean?

The drive towards becoming a net zero carbon city is an ongoing challenge and one that must continue to be a key area of focus for the new Local Plan. New development coming forward needs to mitigate its impacts on the city's emissions to support our pathway to net zero. It was an issue that came up throughout the 2021 issues consultation feedback, though respondents rightfully noted that it cannot be considered in isolation – that it needs to be carefully considered in light of any growth aspirations, balanced with climate adaptation issues (e.g. flooding and overheating) and circular economy principles, and that new development is only one small part of the wider challenge (retrofit of existing properties is an important issue, as is the capability of the underlying energy systems to accommodate net zero ambitions).

Existing policy RE1 made important steps forward from the previous Local Plan, but there are clearly areas of weakness and opportunities for improvement including addressing harder issues like unregulated energy and embodied carbon.

3. Formulating a net zero buildings policy for the Local Plan 2040

3.1. What is a net zero building?

If the city is to deliver upon its target of being net zero by 2040, then we need to ensure that new buildings (which will in most instances still be around from 2040) are operating in accordance with net zero principles. At present, there is no nationally defined methodology or policy guidance for what net zero buildings should look like, although recent government consultations as part of the Future Homes/Buildings Standard have used the term 'zero carbon ready' and described this in relation to homes as being capable of '*becoming zero carbon homes over time as the electricity grid decarbonises, without the need for further costly retrofitting work*'[2]. As is discussed further in the following sections, the government definition focuses on regulated energy sources, which do not account for the total operational energy profile of most buildings.

In the vacuum of guidance for what a true net zero building looks like, representatives of the building industry (such as LETI and UKGBC) have come together to publish their own

[2] *The Future Homes Standard: summary of responses, and government response* (Jan 2021)

guidance/methodology. Figure 1 highlights one such definition from LETI and illustrates the various components that comprise a building that is net zero in operation.

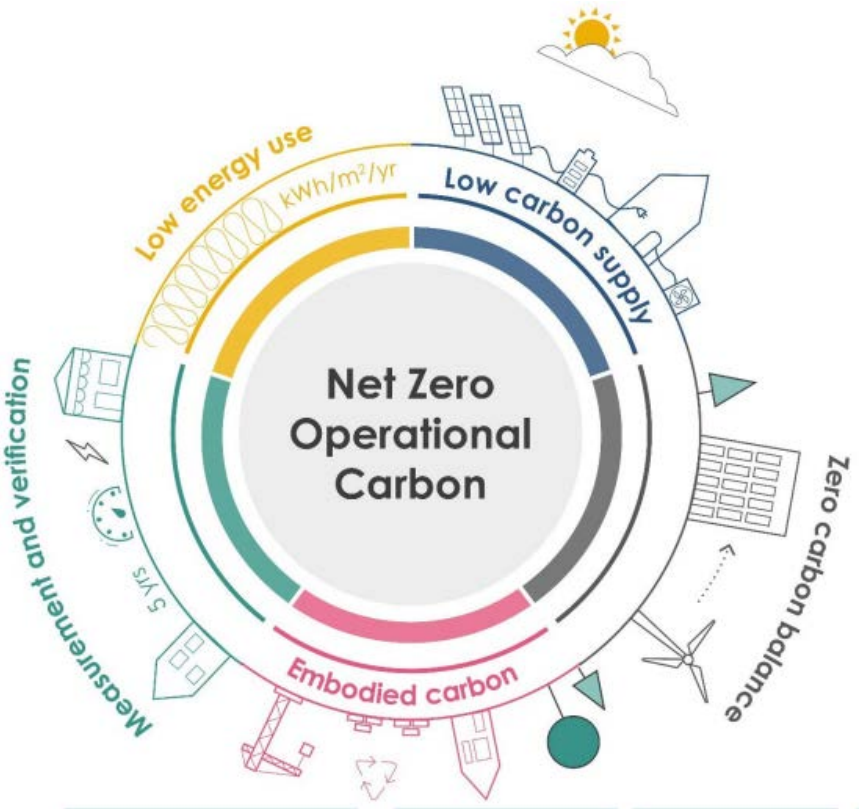


Figure 1: The components of net zero operational carbon development as set out by LETI

In January 2021 the Council accepted a proposal put forward around using a consistent definition of net zero carbon. The definition used was taken from the Green Building Council (UKGBC), which in summary states:

> Net zero carbon – construction (1.1)
> *When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, using offsets or the net export of on-site renewable energy.*
>
> Net zero carbon – operational energy (1.2)
> *When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance, after all efforts have been otherwise made, offset.*

Apart from the issue of embodied carbon, the underlying factor in achieving net zero operational carbon is primarily about energy use in buildings, this is reflected in both the LETI and UKGBC definitions for net zero. Principally, that is the energy used to light the building and power appliances, the energy used to keep homes warm/cool, the energy used to heat water and the energy we use for cooking.

As such, a net zero building in operation will be as energy efficient as possible and its total operational energy needs will be met from renewable, zero carbon sources – which should ideally be incorporated onsite. This understanding has informed the basis of our approach for our proposed policy options, as is the need to be closely aligned to the energy hierarchy.

3.2. Net zero operational energy

The following sets out our thinking in relation to developing options for delivering net zero operational energy buildings that meet the definition set out above.

The energy hierarchy

With energy use being the key source of carbon emissions once a building is in operation, we consider that the first step in approaching the design of net zero development is to take a logical and careful approach to each element of the building and how it influences energy use. The energy hierarchy is a stepped approach to meeting energy needs within new development that helps with designing in a methodical way. Indeed, the National Design Guide[3] (NDG) sets out the importance of following the principles of the hierarchy in order to achieve well-designed places.

Whilst the hierarchy has some variation in how it has been presented by various organisations, it broadly seeks to reduce energy needs in development firstly, before ensuring remaining energy needs are met efficiently and sourced through renewable sources. The format of the hierarchy as defined in the NDG, is as follows:

1. **Reduce energy need** (**be lean)**– through passive design measures

2. **Be efficient in energy use** (**be clean**) – use energy efficient systems such as heat networks for lighting, heating/cooling, operation etc.

3. **Source energy from renewables (be green)** – after energy use has been reduced as much as possible, source remaining needs from renewable technologies, including decentralised sources.

There are variations on the hierarchy which include a fourth step, such as the one used in the London Plan, which is called 'be seen', and involves verifying energy use once built and monitoring this. This fourth step also recognises that where remaining energy needs cannot be met through renewable sources, the carbon footprint of this energy should be offset (an allowance is made for this within the Council adopted net zero definition from the UKGBC also).

Designing in accordance with the energy hierarchy ensures that matters such as fabric efficiency and baseline energy use are considered in advance of where energy is sourced from. This approach promotes efficient building design, encouraging carefully thought-out fabric and layout choices that should help to ensure that the amount of energy needed to run the building is kept as low as possible. It has benefits that include:

- Reducing carbon emissions associated with operation of building, much of which comes for the energy used to heat, light and power.
- Reducing risk of high energy bills associated with heating which is particularly important for those living on low incomes as well as those susceptible to fuel poverty[4].
- Reducing strain on the energy grid, which is likely to increase as reliance on electricity for daily needs such as heating/cooling/cooking/and charging vehicles increases.

[3] National Design Guide (2021): https://www.gov.uk/government/publications/national-design-guide
[4] *Define fuel poverty – does oxford have issues with this? Any stats?*

Our policy options therefore propose embedding the energy hierarchy into policy, specifying that design needs to be in accordance with energy hierarchy principles.

Total operational energy

A significant proportion of a building's carbon footprint upon completion is attributed to the energy required for heating, cooling, lighting as well as running various appliances and systems required by occupants. The term 'operational energy' captures these various energy requirements. LETI report that this can account for approximately 40 to 60% of a building's whole life carbon[5].

Total operational energy
Regulated + Unregulated energy sources

The operational energy of a building is typically broken down into two separate components by the building industry, these are 'regulated' and 'unregulated' energy demands. Typical demands on each type of energy are illustrated figure 2 along with a description of the degree to which they can be affected by design and occupants' behaviour. Planning policy has varying levels of influence over these two sources of energy usage, typically those areas affected more significantly by design are subsequently areas planning can influence more successfully, as opposed to areas affected by occupant behaviour (once the building is finished).

Category	Includes	Affected by Design	Affected by Occupancy Habits	Type
Heating / Cooling	Energy needed to maintain the building at a comfortable temperature	Significantly	Moderately	Regulated
Hot Water	Energy needed to provide a supply of hot water for washing and cleaning	To a limited degree	Significantly	Regulated
Lighting and Auxiliary electricity	Energy need to provide lighting and run the pumps/fans to support heating/cooling/hot water systems	Moderately	Moderately	Regulated
Appliances, specialist uses and 'plug loads'	Appliances, computers and all other electrical loads	To a limited degree	Significantly	Unregulated

Figure 2: Types of energy use in typical buildings – regulated or unregulated? Source: Passivhaus: the route to zero carbon?[6]

Regulated energy

Regulated energy is the energy use that stems from fixed building services and fittings which are generally controlled via the Building Control process. It includes energy associated with space heating, ventilation, hot water and lighting. Typically, Local Plans have tended to include policies that target regulated sources over unregulated sources, including in our own current Local Plan (policy RE1), this is because regulated energy is inherent to the design of the building itself thus planning processes can have a greater control over the efficiency of these systems.

[5] https://www.leti.london/cedg - LETI Climate Emergency Design Guide
[6] https://www.passivhaustrust.org.uk/UserFiles/File/2019.03.20-Passivhaus%20and%20Zero%20Carbon-Publication%20Version1.2(1).pdf

Regulated energy use is controlled through the Building Control process and subject to certain specifications that are set through Building Regulations. For residential development, applicants are required to model their regulated energy use via calculations within the Standard Assessment Procedure (SAP), meanwhile, the Simplified Building Energy Model (SBEM) is used for non-residential development.

The current Local Plan sets more stringent targets for regulated energy use than those specified in Building Regulations, requiring that applicants achieve 40% reduction on carbon emissions over the baseline set in the current Building Regulations (2022) baseline.

The Government has set out that by 2025 it will introduce an uplift to the Building Regulations that will result in 'net zero ready' development in the form of the Future Home Standard and Future Buildings Standard. Buildings constructed to these new standards will theoretically require no further retrofitting to address the carbon footprint of their energy sources and will decarbonise to a point of net zero as the national grid shifts toward completely renewable energy.

Our policy options require net zero regulated energy (100%) as a minimum, from adoption of the plan, which goes beyond current policy (current policy RE1 will not require 100% net zero until 2030 and for residential only).
There is a separate option which proposes going further and including unregulated energy also.

Unregulated energy

Regulated energy is one part of the total energy use of a building once it is in operation, however, the other element is that of unregulated energy sources. Unregulated energy use comes from those remaining sources of energy demand which are not controlled through the Building Regulations. These energy sources are varied and will depend on the type of building but would include systems like appliances (e.g. fridges and cookers), IT equipment, escalators and external lighting.

The introduction of these systems is usually separate to the initial design of the building (or not determined until late in the design process). Unregulated energy demands will vary between occupants and often throughout the lifetime of the building (e.g. retail unit could contain refrigeration units for selling produce for several years before being taken over by another occupier who has no need for them). The less fixed nature of unregulated energy use means that it is harder for designers and the planning process to predict and control, a likely reason for why policies which address this type of energy use have historically been much rarer.

Building Regulations do not currently address unregulated energy use and at time of writing there do not appear to be any solid plans for addressing it in future (the Future Homes and Buildings Standards do not plan to address unregulated emissions). Nevertheless, unregulated energy use can amount to around 50% of the total operational energy of a building (though this figure can vary substantially depending upon the building), which makes it an important part of the carbon reduction challenge. In the absence of plans to address this type of energy use through Building Control, planning policy is left to fill this vacuum. Where unregulated energy use is captured within the requirements of net zero development, the expectation would be that these energy demands are also met through renewable energy sources (ideally onsite).

It's important to note that once the national grid becomes totally renewable, the carbon impact associated with unregulated energy use will become negligible. Ensuring that unregulated energy demands are met through onsite energy generation wherever possible in the meantime reduces emissions associated with this energy use in the meantime, but can have additional benefits in the long term through reducing demands on the central energy grid however.

Our policy options set includes an option for requiring net zero total operational energy (regulated and unregulated) from adoption of the Plan.
There may be a need for setting a threshold for types of development, or scale of development to which this applies, this will be informed by further technical feasibility work over the coming months.

On-site energy generation

Whether net zero energy requirements are applied to regulated sources only, or total operational energy demands, what is clear is that a net zero building in operation should meet these energy needs without increasing greenhouse gas emissions in the atmosphere. This will necessitate a greater shift to electricity as we phase out fossil fuels in our heating systems and in systems (e.g. transport). The latter stage of the energy hierarchy requires that once energy needs have been reduced as much as possible, and that existing energy systems are as efficient as possible, then remaining energy demands should be met via clean, renewable sources.

Over time electricity taken from the national grid is decarbonising as the country shifts from fossil fuel power stations to renewable technologies like wind farms. Relying on national grid power alone, however, ignores other challenges such as rising energy bills (and fuel poverty) as well as the increased strain on the grid that may come with increased energy demands. Decentralised power generation, or power that is generated away from the national grid and/or close to the energy demand, such as through micro-renewables, is an increasingly important alternative.

In a constrained setting such as Oxford, the most likely form of onsite micro-renewable energy generation will be via solar photovoltaic (solar pv) installations[7]. These can be incorporated onto rooftops and have the benefit of being low cost, low maintenance and can be fairly easily installed. Other forms of direct electricity generation (e.g. wind turbines or hydro-power) are likely to be less suitable in the majority of areas, though it would be important for the policy to include an element of flexibility where advancements in these other technologies mean constraints to their installation can be overcome in future. Increasingly, micro-renewable energy technology is being coupled with battery storage that can allow for generated power to be stored at times of surplus, to be used at times of deficit (e.g. at night, when solar power is not readily available).

It may not always be possible to meet energy needs onsite, for example, taller buildings with limited roof space may not be able to accommodate a sufficient area of panels to generate the required power. Equally, these technologies may be less suitable within or close to conservation areas or within the vicinity of listed buildings. Where this is the case, the Council could require that sufficient

[7] Heat pumps are sometimes grouped into this type of technology but these are not considered in this section as they rely upon electricity that needs to be sourced from somewhere else.

off-site power generation be secured to meet the needs of the development if possible, though locating off-site capacity nearby may be challenging due to the lack of available land within the city.

The supporting text to our policy options sets out that we would expect energy needs to be met with renewables through on site generation ideally – this does not rule out generation offsite or payment into an offset scheme where this cannot be achieved.
Once again, we will need to undertake further technical feasibility work to understand whether there are certain thresholds of development size or type to which this would not be practical.

No fossil fuel use

The predominant source of space and water heating in buildings over the last century has typically relied on burning of fossil fuels (e.g. gas boilers) and these are an ongoing source of greenhouse gas emissions associated with the built environment. Fossil fuels are often also used in cooking (e.g. gas ovens). In order to move towards net zero targets, space/water heating needs to be radically decarbonised and fossil fuel burning technologies need to be phased out for zero carbon alternatives.

Indeed, in its 2021 Heat and Buildings Strategy[8], the UK government has set out its ambition of *phasing out the installation of new natural gas boilers from 2035*. The strategy recognises that the future of heating in buildings will need to see a mix of low-carbon technologies used for heating: electrification of heat for buildings using heat pumps, heat networks and potentially switching the natural gas in the grid to low-carbon hydrogen.

Ensuring that new buildings are constructed without a reliance on fossil fuel burning can help to ensure that they do not contribute further to climate change and can also avoid potentially costly retrofitting projects for occupiers at some point in the future.

Equally, fossil fuel burning heat sources contribute to other environmental problems beyond climate change. The entire city has been designated as an Air Quality Management Area (AQMA) in recognition of ongoing air quality problems which can have significant impacts on people's health. The Council's Source Apportionment Study[9] identified that domestic heating is currently responsible for 66% and 47% of all local emissions of Particulate Matter (PM2.5 and PM10) respectively for example. Thus, by building without fossil fuel reliant technologies such as gas boilers, we will be avoiding contributing further to emissions of harmful pollutants like Particulate Matter (PM) as well as other harmful pollutants like Nitrogen Dioxide (NO2).

Our policy options set out that we would not permit fossil fuel use in new development.

Measuring performance – total energy use

[8] https://www.gov.uk/government/publications/heat-and-buildings-strategy
[9] https://www.oxford.gov.uk/downloads/download/1185/oxford_source_apportionment_study

The current RE1 policy primarily measures carbon reduction performance via a % reduction in emissions over a notional target as set out in Building Regulations. Applicants measure their performance using calculations from the Standard Assessment Procedure (SAP) for residential development and the Simplified Building Energy Model (SBEM) for non-residential and submit these as part of an energy statement. This approach is now fairly standard and well-understood across the country, however, it has limitations when it comes to measuring performance regarding net zero including:

- Carbon emissions are calculated using carbon intensity figures associated with various types of energy source – these change over time to reflect changes such as decarbonisation of the energy grid. The issue is that a building built today will measure a different carbon performance to a building built under previous iterations of the carbon intensity figures (or future ones).
- Also, Building Regulations only consider energy use associated with certain types of energy demand (regulated energy sources) and do not address unregulated energy sources.

There are growing calls within industry to measure the performance of new buildings using an Energy Use Intensity (EUI) calculation. EUI calculations are a fairly simple process of measures total energy use for a building and dividing it by the footprint of the building to produce a kWh/m2/year figure. EUI calculations would essentially measure total energy used in the building annually – or the energy use recorded at the meter.

The key benefit of adopting the use of EUI calculations as a way to measure performance of a building is that this would allow for consideration of both regulated and unregulated energy use – something that relying on SAP/SBEM calculations via Building Regulations does not allow for. It would also avoid problems of changing carbon intensities applied to different energy sources/technologies, and would allow for consistent performance comparisons between buildings over time.

At its simplest, demonstrating a net zero carbon building in operation would then be achieved by showing that the total EUI figure for the building is being met from renewable energy (on-site generated preferably) and sourced without relying on fossil fuels.

Our policy options set out that we would measure performance using Energy Use Intensity (EUI) as the primary calculation.
Applicants will need to demonstrate that their total EUI is being met through renewable energy sources - this will either apply to regulated energy only, or regulated and unregulated, depending on which approach is taken

3.3. Further considerations for net zero operational buildings policy

Depending on the approach we take to our net zero policies, there are several more specific targets that may be appropriate for consideration. These relate to the performance of different elements of energy use within buildings, specifically those related to space heating, overall energy use, and onsite renewable energy generation. Each is discussed in turn below, including summaries of the best practice targets recommended from elsewhere.

Energy used for space heating

A primary source of energy use in our buildings is the energy used for heating (and cooling). Buildings with an inefficient layout or poor fabric efficiency, will take more energy to keep comfortably warm (or cool). This is a particular issue when coupled with high energy prices which can result in occupiers being thrust into fuel poverty (spending a high proportion of household income on heating and leaving little left for other basic needs, such as food and clothing).

LETI recommend that a target is set for energy associated with space heating in all new developments. A space heating target is a measure of the thermal efficiency of a building. Figure 3 highlights that a low energy building ought to associate a much smaller proportion of its energy profile to heating. Equally, the UKGBC as part of their stretching requirements for a model operational energy policy propose a similar approach, specifying a target for space heating energy demand[10].

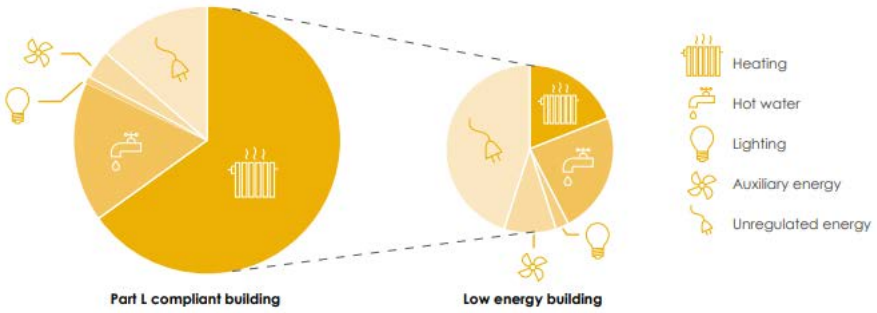


Figure 3: A low energy building attributes a smaller amount of its energy consumption for heating

Typical recommendations include:

1. The Committee on Climate Change[11] - indicate a space heat demand of 15-20 kWh/m2/yr is required for new housing if the UK is to meet its net zero carbon commitments.
2. Passivhaus Institute's Passivhaus Standard[12]: 15kWh/m2/y
3. LETI[13] - residential 35kWh/m2/yr*;* non-residential – 55-65kWh/m2/yr
4. UKGBC New Homes Policy Playbook (2021)[14] – New build homes to deliver ultra-high levels of energy efficiency consistent with a space heat demand of 15-20kWh/m2/year. (*Stretching requirement for policies*).

A target for space heating would promote a 'fabric-first' approach and encourage more efficiently designed buildings, reducing energy demand, reinforcing the first step of the energy hierarchy (be lean). It would also play a positive role in helping to reduce the risk of occupants falling into fuel poverty because of high costs associated with heating their building in winter. Equally, a fabric efficient building, *when coupled with other design features,* can help to reduce the risks of overheating by maintaining a comfortable temperature indoors all year round (reducing heat infiltration during summer as opposed to heat loss in winter).

[10] https://www.ukgbc.org/ukgbc-work/new-homes-policy-playbook/
[11] https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/
[12] https://www.passivhaustrust.org.uk/competitions_and_campaigns/passivhaus-and-zero-carbon/
[13] https://www.leti.london/cedg
[14] https://www.ukgbc.org/ukgbc-work/new-homes-policy-playbook/

Setting an overall energy use target (Energy Use Intensity)

Once energy demands associated with fabric efficiencies and space heating are limited as much as possible, broader energy demands need to be considered and reduced with remaining energy systems as efficient as possible. Careful layout and design choices alongside implementation of energy efficient technologies for heating, lighting etc. can all help to reduce energy demands in a new building.

Setting a broader target beyond that used for space heating could help to ensure that energy use in new buildings is guided through the planning process and in line with expectations for what a net zero building should look like. It can help to reduce strain on the wider energy grid and help to keep energy demands at an appropriate level that could then be met through onsite renewable energy generation. Industry recommendations for EUI targets in net zero development are broadly similar including the following:

1. LETI[15] – *residential 35 kWh/m2/yr; non-residential between (offices) 55 kWh/m2/yr and (schools) 65 kWh/m2/yr*
2. RIBA 2030 target for new development[16] – *residential <35 kWh/m2/yr; non-residential between (offices) <55 kWh/m2/yr and (schools) <60 kWh/m2/yr*

The important thing for net zero buildings is that the overall EUI figure is being met through renewable, zero carbon technologies/energy sources. Setting an EUI target alongside a space heating target would admittedly lead to a more prescriptive and potentially restrictive policy framework for development in the city, however, and this needs to be considered in the formulation of policy.

[15] https://www.leti.london/cedg
[16] https://www.architecture.com/about/policy/climate-action/2030-climate-challenge

3.4. Moving towards Net Zero Construction - Embodied carbon

What do we mean by embodied carbon?

Section 3.3 discussed our approach to addressing net zero carbon buildings in operation but it is important to recognise that this does not constitute the entirety of the carbon emissions of new development. The term Whole Life Carbon encapsulates not only operational carbon emissions (the balance of energy used during the operation of the building) but also embodied carbon, and they are two quite different elements which require differing approaches to understanding and addressing.

A useful explainer to embodied carbon can be found on the LETI website[17]. The term embodied carbon refers to the carbon emitted through energy use and other practices during the construction process, equally it can be emitted during maintenance and redevelopment of a building, as well as at the end of a building's life during demolition. However, another facet of embodied carbon relates to the materials used to construct a building that can also lock away carbon to varying degrees depending on the type of material. It means that existing buildings can act as a carbon sink, storing carbon away that would otherwise be emitted into the atmosphere. Thus, understanding and addressing embodied carbon is a complex challenge.

Unlike approaches to addressing carbon associated with operational energy in buildings, which are now fairly well understood, the concept of embodied carbon and approaches to measuring and limiting it in how we design and build is still developing. Guidance is emerging from a variety of sources, including LETI, the UKGBC and others, but it is still subject to far less standardised guidance and methodologies which makes it more challenging to agree upon a consistent approach to policy.

Why is this an issue for the Local Plan to address?

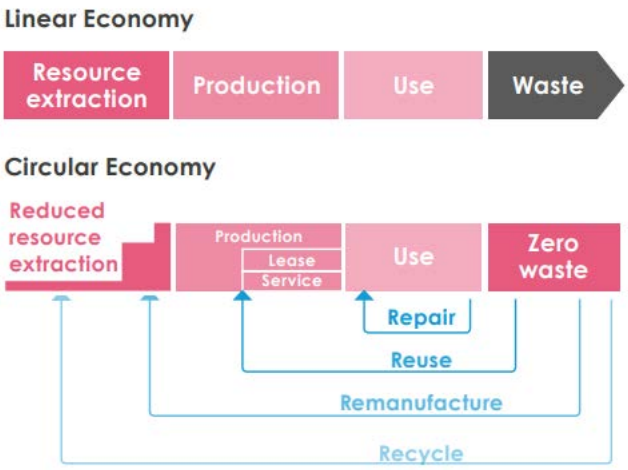
Perhaps reflecting the emerging nature of this topic, this is an area which is still unaddressed within national guidance. At present, it is not included within requirements set out in the Building Regulations and is not referenced in proposals associated within future updates covered by the Future Homes/Buildings Standards. There are calls for this to be rectified in future and this situation may change during the lifetime of the new Local Plan but this issue is still subject to uncertainty for the time being.

However, what is clear, is that as we continue to decarbonise operational energy systems, a greater proportion of remaining emissions from the built environment and construction sector will be associated with this other element of the Whole Life Carbon Cycle. As UKGBC note, most of these embodied emissions occur early during the construction stage[18]. These emissions contribute to climate change in the same way as those associated with operational energy, thus will need to be addressed to fully reach net zero targets in future. In the absence of national standards at present, it is therefore important that we begin to try to build in principles and approaches within local policy that can help build understanding, monitor this problem and address it. Equally, we need to try to retain a level of flexibility that can allow for improving knowledge, innovation and improved guidance that will undoubtedly come in future.

The circular economy

[17] https://www.leti.london/ecp
[18] https://www.ukgbc.org/ukgbc-work/new-homes-policy-playbook/

Addressing the issue of embodied carbon is closely tied with the concept of a circular economy. LETI, in its Embodied Carbon Primer, define the circular economy as a system that is 'restorative or regenerative by intention and design'[19]. In this regard, products, buildings and systems are designed in a way that considers not only how these can be repaired and reused easily, but also how the energy and materials used to construct them can be remanufactured and recycled at the end of their life.



By considering circular economy principles of promoting repair, reuse, remanufacturing and recycling within the design process, we can reduce the raw materials we extract from the environment over time, reduce our energy demands and the impacts we have upon the wider environment. By extension, the carbon emissions embodied within the development process can be reduced too, forming an important step in moving towards net zero construction.

Framing consistent design principles for addressing embodied carbon

The approach to designing for a circular economy leads to a variety of principles that can have an impact on embodied carbon within the development process. The Local Plan, supporting technical advice and design guidance can all take a role in promoting such principles with the goal of reducing carbon embodied within the construction process. Some common principles that would seem appropriate for a policy to promote are as follows:

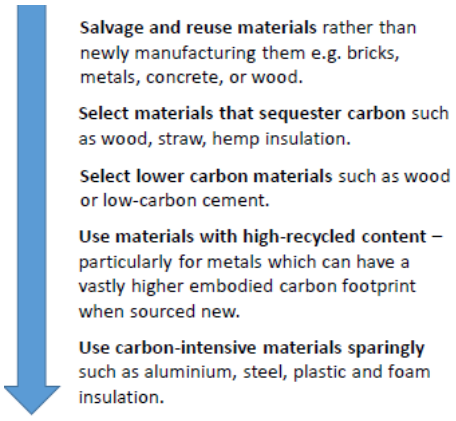
Repair and reuse existing buildings – treat demolition as a last resort, instead consider how any existing buildings or elements of these buildings could be reused/adapted to meet the needs of your proposal. Where demolition is necessary, consider how materials could be saved and repurposed within the construction of the replacement.

Optimise structural design for efficiency – think about how design aspirations can be met with minimal structural elements. Limit material use within the fabric of the building as much as possible, for example, by reducing the amount of finishing used on external elements, or by constructing with materials that can contribute to the overall finish in themselves without the need for additional elements (e.g. rendering) over the top (self-finishing).

[19] https://www.leti.london/ecp

Design for easy maintenance and end of life – make design choices which can allow for systems and structural elements to be easily cared for and maintained to prolong functional life. Consider how design can allow for easy reuse at the end of a building's operational life (be that conversion or disassembly).

Materials selection – think about the energy and resource demands of producing the materials that are being used to construct the building. Where appropriate, try to select materials which have a lower carbon/energy cost than more resource intensive materials. Where possible, consider natural materials that sequester more carbon than it takes to prepare them such as wood, hemp, this can help to offset more carbon intensive materials. Following a materials hierarchy similar to the below could help inform the approach.



Transport of materials/labour – try to source materials locally rather than transporting them in from further afield which is likely to increase carbon emissions associated with the movement of goods to the site. Seek out local trades/skills to work on the construction to reduce transport emissions associated with travelling onto site to work.

Minimise waste and maximise recycling – consider how construction methods can be undertaken in a way that minimises waste production and that waste can be easily recycled. Modern methods of construction, such as designing elements off-site can potentially support this.

Understand and quantify – the design and construction approach should ultimately be informed by a good understanding of energy and resource use that can help to quantify where carbon is being emitted and at what stage, as well as where carbon is potentially being locked in (sequestered). Only through methodically calculating and quantifying embodied carbon can informed approaches be taken to tailoring the design and construction process to reducing additional carbon emissions into the atmosphere.

Complexities with defining principles within Local Plan

When it comes to drafting any policy regarding embodied carbon principles, it will be important to allow for a level of flexibility within the design and development management process that can allow for the most sustainable design approaches to be taken with respect to the whole life of the building. Certain principles may be impractical for certain types of development, others may be difficult to achieve without compromising the sustainability of other elements of the building.

For example, sometimes, materials/products that have a higher embodied energy cost to produce them can have increased benefits for fabric efficiency performance reducing operational energy demands of the building. This would represent a trade-off that will likely need to be considered on a case-by-case basis and it may not always be clear which decision, a material with low embodied carbon cost to produce, versus a highly energy efficient material that comes with a higher embodied carbon cost but that may allow the building to operate closer to net zero during its lifetime.

Equally, as understanding around the topic of embodied carbon continues to grow and the construction industry adapts to new ways of building, any principles set out within local policy will likely be refined and added to. As such it may be more appropriate to distil these principles into some high-level guidance within the Local Plan policy itself and expand upon them within technical advice notes and design guidance that can be more regularly updated in future.

Our policy options set out that we would include high level principles for limiting embodied carbon, including the importance of retaining existing buildings where possible.
Guidance would be expanded upon in accompanying technical advice note (TAN)/SPD.

Understanding embodied emissions in new development - Whole Life Carbon Assessment

As set out in the broad principles for addressing embodied carbon is important to be able to understand and quantify the embodied carbon associated with the various stages of the design and construction process of any proposal before being able to meaningfully take action on reducing it. One means of doing this is through a Whole Life Carbon Assessment.

Whole life/lifecycle carbon assessment is a process which details the predicted carbon emissions associated with each stage of a building's lifecycle. Typically, the lifecycle of a building is broken down into various stages, from the production stage that covers sourcing of construction materials (including extraction of raw materials, transport and fabrication), to construction, then the period during which the building is in use (including maintenance, repair, replacement and refurbishment) to end of life.

UKGBC highlight that data associated with the embodied carbon of different stages of a building's lifetime is not yet fully understood or available, particularly the latter stages of a building's life. However, carbon emissions for materials production and construction stages is now fairly well understood, meaning that assessment of embodied carbon associated with these earlier stages of a building's lifecycle (also the period over which planning policy has most influence), is more practical.

Whilst the process of whole life carbon assessment is one that would likely require additional resources and expertise which may be overly onerous for smaller scale applicants (at least in the short term), it would be an effective way of taking steps to address the issue of embodied carbon on larger developments. Once a proposal has calculated and provided details of its embodied carbon figures associated with the construction process, it would then be possible to evidence approaches that have been taken to reduce embodied carbon at each stage of the process and quantify the levels of reduction these approaches have achieved.

Our policy options set includes an option that would set more specific requirements for major development in relation to embodied carbon, requiring a measurement of embodied carbon during construction through a recognised methodology (e.g a Whole Life Cycle Carbon Assessment) and demonstrating actions taken to reduce this as much as possible.
We include a caveat that this would be superseeded by any future updates to Building Regulations that introduced comparable requirements on embodied carbon there.

Potential routes for future policy or supporting guidance relating to embodied carbon

It is acknowledged that embodied carbon is a complex issue, and one around which data and understanding is still emerging across the development industry. There is an opportunity for the Local Plan 2040 to begin to take greater steps in addressing this issue whilst also retaining a level of flexibility and scope for advances in knowledge and technologies that may occur during the life time of the Local Plan.

The policy options set out will not address embodied carbon in totality at this stage but it is considered that they set out a strong stepping stone on which to build going forwards. Defining common principles and design approaches that can help secure reduced embodied carbon will be applicable to all scales of development from extensions and single dwelling applications to larger major schemes. Keeping these principles high level within a policy whilst backing them up with additional guidance and support within a technical advice note would allow for these principles to be updated to reflect emerging best practice throughout the lifetime of the plan.

Equally, the requirement for whole life carbon assessment on major applications would begin to drive greater understanding and quantifying of embodied carbon associated with the largest development schemes occurring in the city.

3.5. Broader issues

Carbon offsetting

Definitions of net zero carbon development often allow for a level of offsetting where difficult to eliminate carbon emissions are not able to be fully addressed onsite through the design of the building. Indeed, the UKGBC definition adopted by the Council in 2021 makes specific reference to this allowance. Offsetting typically works by making a one-off payment into a fund, per tonne of carbon that is not mitigated on a site, and then spent to offset the same amount of carbon elsewhere.

As touched upon earlier in the paper, there may be certain types of development which will struggle to fully meet all energy needs through renewable energy generation on a site, particularly if we are to require applicants to demonstrate that unregulated energy use is net zero. We will be commissioning additional feasibility work to understand what scenarios may face challenges like this, but evidence elsewhere suggests that it could be the case on blocks of flats with limited roof space to accommodate solar panels, or for more energy intensive commercial/non-residential uses. In these instances, to demonstrate no net increase in emissions due to energy demands of a

development, the fall-back option may need to be offsite generation or else payment into an offset scheme that could use the funds to implement carbon reduction measures on existing buildings elsewhere in the city.

It is considered that off-setting would need to be an option of last resort and any application proposing this would need to demonstrate that all other options for mitigating emissions (having clearly followed the steps of the energy hierarchy) have been exhausted. The process of offsetting comes with a variety of challenges, particularly in that it allows for emissions to continue at source for the time being. However, an off-setting mechanism could garner potential benefits for securing funding that can deliver mitigation of emissions elsewhere, e.g. retro-fitting existing buildings.

If the Council was to pursue such an option, further work would be needed to identify viable projects that could accommodate the offsetting. The process would also come with administrative demands to ensure that funds collected are appropriately used elsewhere to deliver 1-2-1 carbon reduction. The feasibility and viability of such a scheme would need to be explored further if it is determined that such an option is considered necessary as part of the future Local Plan.

Our policy options set includes an option for accepting offsetting of unmitigated carbon emissions associated with operational energy use as a last resort, where measures to reduce carbon on site have been exhausted and with strict principles for how/when this would be accepted

Retrofitting existing buildings

As detailed in the issues background paper on carbon reduction, the primary source of emissions that make up the city's existing carbon footprint comes from the built environment and there is a significant need for retrofitting to install carbon reduction measures into these buildings if the city is to attain net zero by 2040. These buildings have already gone through the planning process, and as such, the new Local Plan will have very little influence over them, unless they come forward for planning permission associated with redevelopment in future.

Furthermore, many retrofitting measures, including installation of renewable energy generation technologies like solar panels, are classed as permitted development under the General Permitted Development Order (GDPO). This means that planning permission would not usually be required for such works – unless the buildings are listed, or within a conservation area, or if the works are more extensive than what is covered by the GPDO.

The Local Plan can however play a role in positively supporting retrofitting where it does require planning permission. Equally, for more complex situations, such as where works are planned for a historic building, there may be a role for policy in providing more clarity around what measures may be more acceptable or likely to secure permission, and what could be considered more harmful, and therefore less likely to secure permission.

Recognising the important need for retrofitting measures to secure carbon reduction, we have included a set of policy options that seek to positively support retrofitting.
We have included an option that specifically addresses works to historic buildings proposing that we would be explicit in setting out a set of key principles to follow, potentially flagging which measures would be more or less likely to cause harm (e.g., permanent versus temporary), and how levels of harm would be assessed against public benefit.